Contextual interference

IMPACT

INTRODUCTION

The Cambridge Dictionary defines “impact” as “a powerful effect that something, especially something new, has on a situation or person” [1]. Concerning this doctoral thesis, “something new” can be seen as the results we obtained with the research that was performed. The nature and strength of the effect our research, in which situations the effect comes into play and which persons are involved, is discussed in the follwoing paragraphs.

THE RELEVANCE OF THIS RESEARCH

According to Article 32 of the Swiss Federal Health Insurance Act, benefits covered by compulsory health insurance need to be economical, effective and expedient [2]. To ensure optimal treatment of patients, in this case the treatment of the young persons with neurological disorders, evaluating the effectiveness of therapies is needed. Hence, investigating the potential benefit due to contextual interference on motor learning is meaningful. Our systematic review brought forth, that there is a knowledge gap when it comes to the effect of contextual interference in children with brain lesions.

New technologies can seem promising in terms of effectiveness and are increasingly applied in the rehabilitation setting. Yet, it is still not completely understood how these technologies should be implemented best as an integral part of rehabilitation therapies. Implementing new technologies in research is of interest and relevance too as this provides knowledge in this rather young field. We used the ChARMin robot for our projects and thus aimed to gain more knowledge about the use of robotic devices in research. When applying any assessment, be it a conventional assessment or provided by new technologies, it is important to know the clinimetric properties (i.e. reliability, validity, and responsiveness) for the particular population within the context of the clinical application (i.e. for diagnostics, evaluation or prediction). Clinimetric properties are quality characteristics of an assessment. Having knowledge about the clinimetric properties of an assessment is significant as it puts the effort and benefit ratio into perspective for the user.

We assessed the reliability of assessments measuring upper limb functions provided by ChARMin. Reliability is an important clinimetric ability referring to the repeatability and consistency of the results recorded with the assessment. A necessary and important step within the research process. However, just like all clinimetric properties, reliability also depends on the population as well as the context in which the assessments are applied. Therefore, we might have provided important information that can be applied to our setting, with the children undergoing

neurorehabilitation, yet, this information is not transferable to other populations or settings. Hence, the relevance of our reliability results is limited.

As economical aspects are not only an issue in the clinical area but also in research, a careful consideration of the limited resources is required. Research is mainly financed by third party money and justification for spending these funds is required. Hence, it is of relevance to assess whether conducting an effectiveness study requiring a lot of resources is actually feasible.

WHO BENEFITS FROM THIS RESEARCH?

An important aspect of the impact of research, are the persons or groups of persons deriving advantage or benefit from this research. The relevance that has been evaluated in the previous paragraph and the benefit are dependent on each other as the relevance is determined by these very same people. So who benefits from this research?

The objectives of this doctoral thesis that were defined in the beginning, focused on the improvement of therapy schedules. We expected to receive and transfer the knowledge about a higher benefit of one practice order over the other one to clinical practice. Yet, what we gained is knowledge about processes needed before even starting with a large effectiveness study on that goal. Initially, we expected that we could present an optimised therapy schedule based on findings about whether blocked or random practice would be beneficiary for the neuropaediatric population. Hence, children with brain lesions undergoing neurorehabilitation would be beneficiaries in terms of them profiting from this improved schedule with better motor learning outcomes. Additionally, their therapists would benefit in terms of gained knowledge about how to organise a practice session to attain an optimised learning situation. Yet, as it turned out, the benefits of this research were distributed differently, this is discussed in the following paragraphs.

The research community

One group of persons potentially deriving advantage from research is the research community. Reading studies published by peers leads to an increase in one's own knowledge, be it methodological or content-related. Promoting pilot studies prevents researchers and funders from spending resources to studies doomed to fail: "[…] it is worth making clear that a pilot study that shows the main study is not likely to be feasible is not a failed (pilot) study. In fact, it is a success- because you avoided wasting scarce resources on a study destined for failure!" p. 6 [3] [2]. Hence, findings of our pilot study prevented our research group from spending third party money on a project that turned out not feasible, and also protected a vulnerable population of children with brain lesions from attending a study without prospective gains. Yet, our findings contributed to the body of knowledge in the field of methodology of pilot

studies. This could promote the conduct and publication of pilot studies in our field. Our systematic review showed that studies assessing the contextual interference effect in children were of very low methodological quality. Publishing study protocols in peer reviewed journals exposes elaborated research ideas to an audience of experts, before the actual study is conducted. This is an important step to make full research processes more transparent and therewith increase the quality of research. The conclusion of this dissertation is that it is valuable to look outside the box of conventional research approaches in paediatric neurorehabilitation. The rather small field, the heterogeneous population, the individual presentation of disease patterns or levels of severity and disability makes it difficult to design and follow the strict rules of a randomised controlled effectiveness trial needed to attain a sound methodology. More preparation including a feasibility randomised controlled trial as part of the whole trajectory towards an effectiveness randomised controlled trial is urgently needed. This has implications for future research, namely, increased applications of more and also different research approaches in paediatric neurorehabilitation. For example, more individual approaches could probably contribute to make the research more meaningful for our young participants and to be able to draw valid conclusions. First, the awareness and then the promotion of more high quality scientific approaches will be of great importance in our field.

The developers of robotic devices

Robotic therapies and assessments became popular in the last decades. They provide certain advantages compared to conventional therapies (e.g. number of repetitions, intensity, highly standardised measurements). Yet, despite these advantages and the appealing futuristic appearance of new technologies, it is important to look at what is behind. Clinical and research experience with ChARMin is not yet extensive. With the results obtained with the reliability investigation of the ChARMin assessments, we added information that will be used to improve and further develop the measurement of upper limb functions with ChARMin. As an example, we recommended to adapt the strength assessment in such a way that the instructions for the participants would be easier to understand and follow. This would improve reliability of the strength measurements. This recommendation has been well received and partly already been implemented for a future update of the ChARMin software. However, as ChARMin is the only device of its kind, these updates will only affect our centre and no immediate generalisation can be made.

Persons involved in clinical practice: children and therapists

Children with affected upper limb function undergoing neurorehabilitation in our centre still profit to some extent from the results obtained from our reliability study. Assessments were and will be adapted according to our experience, most likely leading to more reliable outcomes; others were not applied in studies as they showed low reliability and adaptations were not possible. In the clinical setting, therapists

can for example evaluate whether changes measured with ChARMin assessments actually reflect a real change and are not only due to a measurement error when comparing them with the results of the absolute reliability measures (i.e. smallest real difference). Knowing about a true change ensures children that the training is beneficial for them and potentially increases their motivation.

In the course of the pilot study, new exergames have been programmed, increasing the range of robot exergames for practicing the function of the upper limbs in our centre. These innovations could provide for more motivation, variety and diversity in training. Again, for now, this benefit only applies to our centre.

KNOWLEDGE TRANSFER

Spreading knowledge and making it accessible and usable is a fundamental part of the management of knowledge [4] [3]. Knowledge without transfer is an artefact. Knowledge can be transferred to different kinds of receivers with various media. The scientific findings from this thesis have partly been published in scientific journals and will be published in the future. Knowledge addressing the interested scientific community thus will be transmitted via relevant journals. Yet, optimally, transfer would also include the use or implementation of the according knowledge. This again requires the receiver to absorb the provided information and apply it in his work field.

Knowledge addressing the developer of the robotic device has already been transferred. Direct contact with the developer about the issues of the robotic device and its software led to several adaptations already during this doctoral thesis. Improvements were implemented due to the findings of not only the reliability study but also due to the experiences we made during the feasibility and pilot study process. Further adaptations are planned and will be implemented shortly. Hence, within our centre, this part of knowledge has not only been transmitted but also been transferred.

Knowledge about the contextual interference effect as well as about difficulties of conducting an effectiveness study obtained in the course of this thesis has also been spread within our centre, at national and international congresses. Findings were presented on posters and with oral presentations. Hence, direct contact and discussions with therapists, doctors and interested researchers have taken place. Yet, also here, with this approach, there is limited influence on the knowledge implementation. The most impact could take place within the research community from both, inside and outside our centre, by promoting, that more individual and alternative research approaches could be considered in the very heterogeneous field of paediatric neurorehabilitation.

The big challenge of knowledge transfer and implementation in this case is, that

the results we obtained are mostly limited to our centre. The implementation of the knowledge we gained about the content as well as the methodology will need a long and complex way to go to be implemented in a broader context. Intensive implementation strategies are needed to reach that goal.

CONCLUSION

The research that has been conducted in the context of this doctoral thesis, is relevant for both, research and clinical practice, but mainly in our centre for the moment. Our research group, the research community, developers of robotic devices as well as therapists and children undergoing neurorehabilitation, benefit to a greater or lesser extent. In this thesis we pointed out directions for future research, and that more individual approaches (e.g. single subject design studies, mixed-methods design studies) could be indicated in this heterogeneous population. Reducing the burden for the participants and their families in general as only a fractional part of participants is needed for a study, would be one advantage. Most importantly, the inclusion of children, their parents and other important stakeholders in the research process, would most certainly increase the relevance of the research and therewith its impact.

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